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THE IMPACT OF BIG DATA ON SPORTS TRAINING DECISION-MAKING AND COACHING LEADERSHIP ENHANCEMENT

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ABSTRACT

Big data technology has transformed sports training and coaching by enabling data-driven decision-making and performance optimization. This study examines its impact on training decisions and coaching leadership using university basketball as a case study. The findings show that big data enhances training efficiency through individualized plans, real-time monitoring, and tactical adjustments, leading to measurable improvements in player and team performance. Big data also strengthens coaching leadership by providing objective insights, improving communication through visual tools, and enabling self-assessment of strategies. Tactical optimizations, such as improved defensive coverage and balanced shooting distribution, highlight the value of data-driven approaches in addressing weaknesses and enhancing game strategies. While challenges like data standardization and privacy concerns remain, big data's integration into sports continues to unlock new opportunities for optimizing performance and advancing team success.

KEYWORDS: Big Data; Sports Training; Decision-Making; Coaching Leadership

1. INTRODUCTION

In recent years, with the rapid development of information technology, the application of big data in sports has become increasingly pervasive, bringing revolutionary changes to sports training, event management, and the enhancement of coaching leadership (Torgler, 2023). In modern competitive

sports, the scientific basis of training decisions and the leadership abilities of coaches play a critical role in shaping athletes' performances and the overall development of teams. However, traditional training models and decision-making approaches often rely on the subjective experience and intuition of coaches, lacking systematization and objectivity. These limitations make it difficult to meet the demands for efficiency and precision in contemporary sports. The introduction of big data has provided quantitative support and advanced analytical possibilities, significantly contributing to improvements in both training decisions and coaching leadership (Ciampi et al., 2021). At its core, big data technology focuses on the collection, analysis, and application of large-scale datasets. Through wearable devices, sensors, video analysis, and intelligent algorithms, big data captures multidimensional information such as physiological metrics, movement trajectories, technical actions, and psychological states of athletes during training and competition (Jin & Zhan, 2024). These datasets provide a solid foundation for in-depth analysis of individual athlete characteristics and the personalized design of training plans. For instance, in basketball, big data not only monitors athletes' workload and performance but also analyzes team tactical execution efficiency and the technical-tactical tendencies of opponents. This data-driven decision-making approach enhances the precision and effectiveness of training while making coaching leadership more scientific and data-oriented. In the domain of training decision-making, big data addresses the shortcomings of traditional training models. Historically, training plans primarily relied on the subjective judgment of coaches and basic statistical data, which often failed to fully reflect the athletes' actual conditions. By leveraging real-time data collection and dynamic analysis, big data enables coaches to comprehensively understand athletes' physiological and technical profiles, allowing for the creation of more targeted training plans. For example, big data can analyze metrics such as heart rate, fatigue levels, and workload to dynamically adjust training intensity, reducing the risk of overtraining injuries while optimizing training outcomes (Wang et al., 2024). Additionally, historical data accumulation combined with machine learning algorithms can predict athletes' future performance and potential development, providing a scientific basis for the long-term optimization of training programs. In terms of coaching leadership, big data provides coaches with comprehensive and precise management tools. Leadership is a core factor in the success of sports teams, and a coach's decision-making abilities, communication skills, and tactical command are directly linked to team performance and cohesion. Big data enables coaches to move beyond traditional, experience-based management approaches, offering objective insights into athletes' performance through data analysis (Fang, 2024). By analyzing game data, coaches can clearly identify each athlete's strengths and weaknesses during competition, allowing them to adjust lineups and tactics accordingly. This data-driven leadership style enhances decision-making accuracy while fostering trust and improving communication between coaches

and athletes. Moreover, big data offers powerful support for in-game decision-making. In high-level competitive matches, the accuracy and adaptability of in-game coaching decisions have a direct impact on outcomes (Pu et al., 2024). Through real-time data feedback, coaches can quickly assess players' performances, detect tactical changes from opponents, and monitor game rhythm, enabling the formulation of highly targeted tactical adjustments. For example, in basketball, real-time analysis of opponents' defensive alignments and key player performances allows coaches to promptly modify offensive strategies to improve scoring efficiency (Anzer, 2022). This capability strengthens decision-making in critical moments and underscores the role of big data in optimizing coaching leadership. In addition to big data, the rapid advancement of multi-UAV cooperative technologies and distributed processing systems has provided strong technical support for sports research. Multi-UAV systems enable dynamic tracking of athletes' movements during training and competition, offering comprehensive spatiotemporal data that aids in detailed performance analysis (Olaniyan, 2020). Distributed processing technologies further enhance the capacity to handle and analyze massive datasets collected from multi-UAV systems in real time, ensuring high-speed computation and efficient data integration (Chen et al.). These technologies support applications such as tactical simulations, trajectory analysis, and event broadcasting, significantly enriching the research and development landscape in sports. Despite its immense potential, the application of big data in sports faces several challenges. First, the collection and analysis of data depend on sophisticated technological tools and equipment, and compatibility issues between different devices may affect the accuracy and completeness of data (Qi et al., 2021). Second, safeguarding athletes' privacy while fully utilizing their data remains an urgent issue. Additionally, the complexity of big data analysis results often makes it difficult to translate findings into actionable guidance that coaches and athletes can easily understand and apply (Cossich et al., 2023). These challenges highlight the need for greater expertise and interdisciplinary collaboration in the implementation of big data technologies. The role of big data in enhancing sports training decision-making and coaching leadership is undeniable. Through real-time data collection and analysis, big data enables training to become more precise and scientific while providing coaches with powerful tools for decision-making and management (Rajšp & Fister Jr, 2020). Particularly in basketball, big data applications have become essential for improving training efficiency, optimizing tactical decisions, and strengthening leadership. Looking forward, as big data technology continues to evolve and mature, its applications in sports are expected to expand further, bringing even greater value to athlete development and team management. This study, using basketball as a case example, delves into the specific impacts of big data on training decision-making and coaching leadership, aiming to offer new insights and references for sports science research and practice.

2. The Impact of Big Data on Training Decision-Making

2.1 Personalized Training Plan Development

The application of big data technology is fundamentally transforming traditional training design methods, making the development of personalized training plans more scientific and efficient. By leveraging big data, coaches can comprehensively collect multidimensional data on athletes' physiological, technical, and psychological states, such as heart rate fluctuations, shooting trajectories, running distances, and emotional states (Sampaio et al., 2024). Through in-depth analysis, this data reveals the unique characteristics and weaknesses of athletes, providing a scientific basis for the personalized design of training programs. If a basketball player has a low shooting accuracy, big data analysis can identify issues such as shot angles or force distribution, enabling the design of targeted shooting correction training to strengthen these weaknesses. Additionally, the real-time feedback capability of big data allows for dynamic adjustments to training plans. During training, coaches can monitor an athlete's fatigue levels, heart rate, and technical performance to optimize training content in real time, thereby avoiding overtraining injuries and improving overall effectiveness. This dynamic adjustment mechanism not only enhances the precision of training but also significantly improves its efficiency. Practical evidence shows that big data-driven personalized training plans can significantly enhance athlete performance and provide coaches with more intuitive and effective decision-making support. As technology continues to advance, personalized training is expected to play an increasingly important role in future sports, unlocking the full potential of athletes and boosting the overall competitiveness of teams.

2.2 Real-Time Monitoring and Feedback

Real-time monitoring and feedback represent a core advantage of big data technology in sports training. By collecting and analyzing athletes' real-time performance during training and competition, coaches are provided with timely insights for adjustments, thereby improving the scientific rigor and efficiency of training. Wearable devices, sensors, and video analysis technology can capture comprehensive data on athletes' physiological states, technical movements, and biomechanics, such as heart rate, respiratory frequency, running speed, and movement trajectories. This data is processed through big data platforms and presented in intuitive charts or alert systems, enabling coaches to quickly assess an athlete's current condition. This capability is particularly beneficial for managing training loads and fatigue. By monitoring metrics such as heart rate and lactate levels, coaches can identify signs of excessive fatigue or inadequate recovery, allowing them to adjust training intensity accordingly. This reduces the risk of overtraining and associated injuries. For instance, in high-intensity interval training, real-time

feedback can guide coaches on the appropriate rest duration and load intensity for subsequent training rounds. Moreover, real-time monitoring significantly optimizes technical training. Through video capture and analysis, coaches can detect subtle issues in an athlete's movements, such as uneven stride frequency during running or deviations in shooting angles and provide immediate corrections during training. This feedback-driven mechanism not only improves the precision of training but also accelerates athletes' learning of new techniques and their correction of existing flaws. Real-time monitoring and feedback enable coaches to make timely and accurate adjustments to an athlete's condition and training outcomes. This dynamic approach to training not only effectively reduces injury risks but also helps athletes maintain optimal performance during training and competition, providing a solid foundation for improved efficiency and results.

2.3 Tactical Training Optimization

In competitive sports, the scientific and precise execution of tactical training is critical for enhancing overall team competitiveness. Big data technology offers revolutionary support for tactical optimization by enabling deep analysis of match footage and training data. Big data can reveal key details such as player movement trajectories, passing patterns, offensive efficiency, and defensive capabilities, providing a scientific basis for the design and improvement of tactical training. Video analysis technology can record shooting accuracy and running heat maps for players in different areas of the court. Coaches can use this data to identify the team's offensive strengths and develop targeted training programs to address weaknesses. Similarly, big data can analyze opponents' tactical tendencies by examining metrics such as offensive distribution, defensive vulnerabilities, and the performance of key players. These insights allow coaches to develop counter-strategies. For instance, analyzing an opponent's defensive formations can help coaches design quick ball-movement tactics to break through defensive lines(Kaya, 2014). Big data supports real-time tactical adjustments. During training simulations, dynamic analysis of player performance and tactical execution efficiency enables coaches to refine training methods and ensure that tactics are effectively executed in real-game scenarios. By providing detailed and objective analysis, big data significantly enhances the precision and flexibility of tactical training. This enables teams to execute strategies more efficiently in complex and rapidly changing game environments, ultimately improving overall competitiveness(Qi et al., 2024).

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4. Case Study: Application of Big Data in Basketball Training

4.1 Personalized Training Case

In the training of university basketball players, the application of big data technology provides scientific support for personalized training. By collecting and analyzing real-time physiological, technical, and tactical data, coaches can design targeted training programs tailored to each athlete's characteristics and

needs, significantly improving training efficiency and competitive performance.

Case Background: This study examines a university basketball team that leveraged big data to enhance individual athlete performance and team tactical execution. Using wearable devices and video analysis tools, the coaching team collected key performance data during training and games, including shooting accuracy, movement heatmaps, contest efficiency, and energy expenditure. The analysis revealed deficiencies in the rebounding and low-post defensive abilities of the inside players, while outside players exhibited subpar three-point accuracy and inadequate breakthrough skills. Based on these findings, the coaches developed targeted training programs for players in different positions. Data showed that the inside players had a rebound contest rate of only 45%, below the average for similar-level competitions. To address this, the coaching team implemented high-intensity physical confrontation drills, including under-the-basket positioning, contested rebounding exercises, and core strength enhancement routines (e.g., weighted squats and deep core muscle training).

Additionally, feedback data indicated that these players had low shooting accuracy in the low post, prompting the inclusion of post-up moves and footwork training to improve stability and efficiency in close-range scoring. The analysis revealed that outside players had a three-point shooting accuracy of just 32%, far below the desired standard. Using video capture technology, the coaching staff identified issues such as low shot release angles and inconsistent force control. Consequently, three-point shooting drills were introduced, focusing on hand position correction and weak-zone scoring through heatmap-based shooting tests. To enhance breakthrough efficiency, the coaches also designed combination drills incorporating quick penetration and pull-up jump shots. At the conclusion of the four-week personalized training program, a comprehensive performance evaluation was conducted using big data technology. The comparison of core metrics before and after training was presented in both bar charts and detailed tables, highlighting the improvements achieved in specific training objectives and reinforcing the scientific validity and applicability of the evaluation process.

Table 1: Performance Comparison Before and After Training.

TRAINING CATEGORY	BEFORE TRAINING (%)	AFTER TRAINING (%)	IMPROVEMENT (%)
REBOUND CONTEST RATE	45	60	+15
LOW-POST SHOOTING ACCURACY	52	64	+12
THREE-POINT ACCURACY	32	39	+7
BREAKTHROUGH SUCCESS RATE	58	67	+9
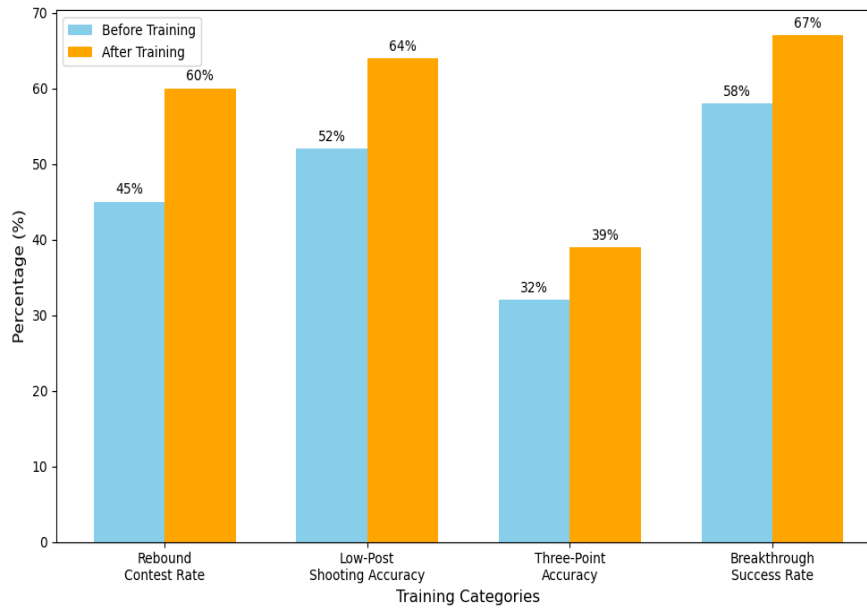
Figure 1: Performance Comparison Before and After Training.

As shown in Figure 1 and Table 1, inside players achieved significant improvements in their rebounding and low-post performance. The rebound contest rate increased from 45% to 60%, a gain attributed to high-intensity confrontation drills and core strength training. Meanwhile, low-post shooting accuracy improved from 52% to 64%, reflecting the effectiveness of post-up and footwork optimization. For outside players, three-point shooting accuracy increased from 32% to 39%. This improvement was driven by hand position correction drills and weak-zone scoring exercises identified through shooting heatmaps. Additionally, breakthrough success rates rose from 58% to 67%, demonstrating the impact of quick penetration and pull-up jump shot drills. These outcomes are not only visually represented in bar charts but also comprehensively summarized in the table, clearly showcasing the changes in key performance indicators.

The bar chart clearly illustrates these performance improvements. Inside players demonstrated substantial gains in rebounding and low-post shooting efficiency, while outside players showed marked progress in three-point accuracy and breakthroughs. Furthermore, the shooting heatmap analysis verified that training targeted weak areas effectively, resulting in a more even scoring distribution and improved efficiency. By integrating both table-based and visual analyses, coaches can comprehensively understand athletes' progress and use the data to design more precise follow-up training plans. This scientific evaluation approach enhances the management of training while boosting team competitiveness. Additionally, athletes can visually observe their progress, fostering greater motivation and engagement. The combination of big data and personalized training thus provides a solid foundation for refining

sports performance and team success.

## 4.2 Tactical Optimization Case: Enhancing Performance Through Data-Driven Adjustments

Tactical flexibility and precise adjustments play a critical role in improving team performance. Leveraging big data analysis, a university basketball team identified weaknesses in its defensive and offensive strategies during recent games. The analysis revealed key challenges, such as insufficient defensive pressure on three-point shooters and inefficient fast-break execution. Additionally, mid-range shooting opportunities were overly concentrated in central areas, limiting offensive diversity.

To address these issues, the coaching staff developed a two-week training program focused on tactical optimization. This section presents the results of the training, supported by visual tools, including heatmaps, bar charts, and statistical tables. Following the implementation of the tactical adjustments, the team achieved significant improvements. Defensive rotations were optimized to enhance coverage of high-percentage shooting zones, reducing opponent effectiveness from three-point range. Fast-break execution was streamlined, increasing the team's scoring efficiency in transition. On offense, shooting distribution across the court became more balanced, with notable improvements in underutilized areas such as the left and right wings. These changes were measured using both quantitative data and visual analyses.

**Table 2:** Tactical Metrics Before and After Training

TACTICAL METRICS		BEFORE TRAINING (%)	AFTER TRAINING (%)	IMPROVEMENT (%)
OPPONENT ACCURACY	3-POINT	45	38	-7
FAST BREAK RATE	SUCCESS	50	62	+12
MID-RANGE ACCURACY	SHOOTING	35	42	+7
SHOOTING BALANCE	DISTRIBUTION	Concentrated	Balanced	-

Table 2 summarizes the key tactical metrics before and after the training program. It highlights improvements in opponent three-point accuracy, fast-break success rate, and mid-range shooting accuracy, while also addressing shooting distribution balance. Figure 2 provides a clear comparison of key tactical metrics before and after training, emphasizing the substantial gains in fast-break success rate and mid-range shooting accuracy, alongside the reduction in opponent three-point accuracy.
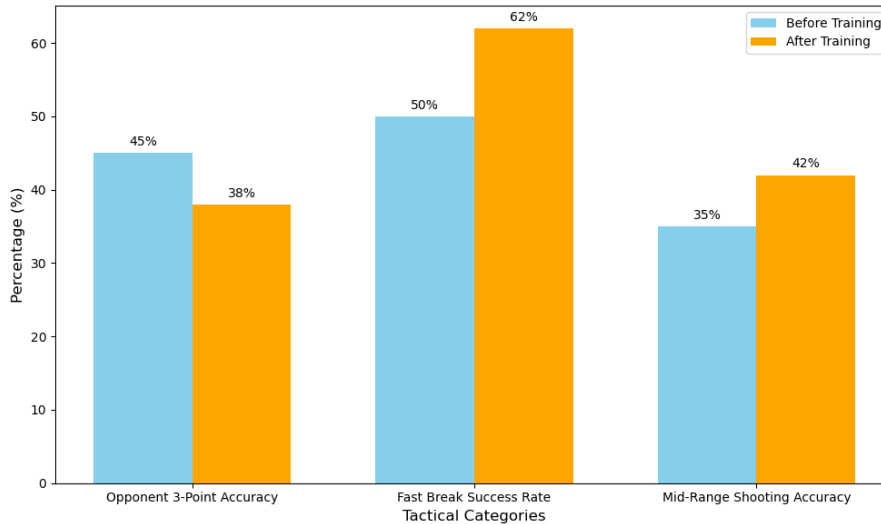
Figure 2: Key Tactical Metrics: Comparison Before and After Training

Figure 3 provide additional insight into the changes in shooting distribution before and after training. These visualizations highlight the areas of the court where shooting performance improved, particularly in the wings and corners. The first heatmap shows the team's shooting distribution before training, where accuracy was heavily concentrated in central areas, with poor performance in the left and right wings. The second heatmap demonstrates the effects of training, with improved accuracy across all court areas and a more balanced distribution of shot attempts.
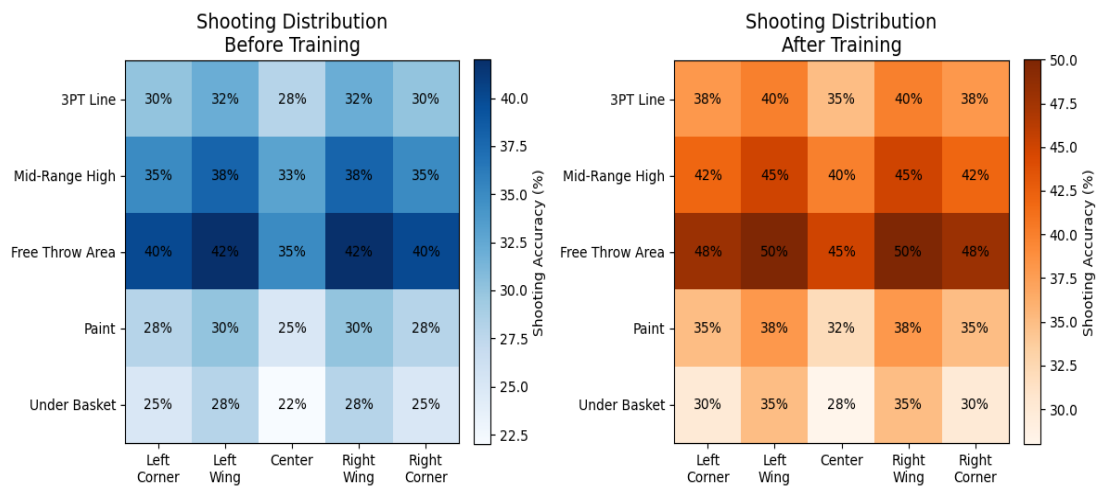
Figure 3: Shooting Distribution Before and After Training

The results clearly demonstrate the success of the tactical optimization program. Defensively, the reduction in opponent three-point accuracy from 45% to 38% reflects the improved defensive pressure in the wings and corners. Offensively, the fast-break success rate increased from 50% to 62%, showcasing the effectiveness of rapid ball movement and transition scoring

drills. Finally, mid-range shooting accuracy improved from 35% to 42%, with a notable balance in shooting distribution across the court. By combining quantitative analysis (table), comparative visuals (bar chart), and spatial performance data (heatmaps), this tactical optimization case exemplifies the power of big data in improving basketball performance. It highlights how data-driven strategies can identify weaknesses, inform targeted training, and achieve measurable improvements in both individual and team performance.

5. Conclusion

The integration of big data technology into sports training and coaching has profoundly transformed traditional methods, offering a new paradigm for optimizing both individual and team performance. This study explored the impact of big data on training decision-making and the enhancement of coaching leadership, using university basketball as a case study. The findings illustrate how data-driven approaches not only refine tactical strategies but also empower coaches to make evidence-based decisions, resulting in significant improvements in athletic performance and team cohesion. In the context of training decision-making, big data provides unprecedented access to detailed, real-time performance metrics, enabling the design of individualized training plans tailored to the specific needs of each athlete. Through continuous monitoring and feedback, coaches can dynamically adjust training loads, mitigate injury risks, and ensure optimal performance. The case study demonstrated clear progress in key metrics such as fast-break success rate, mid-range shooting accuracy, and defensive effectiveness, underscoring the efficacy of targeted, data-driven interventions. In terms of coaching leadership, big data fosters more effective communication and enhances trust within the team by providing objective, quantifiable insights into player performance. Coaches can utilize visual tools such as heatmaps and statistical charts to communicate strategies and progress to athletes more clearly, minimizing misunderstandings and increasing buy-in from players. Furthermore, data analytics allow coaches to self-assess their tactical decisions, refine their leadership styles, and adopt best practices from successful peers, further elevating their effectiveness as leaders. The application of big data in tactical optimization has also proven to be invaluable. By analyzing opponent tendencies and team weaknesses, coaches can devise more precise game plans and improve in-game adaptability. The case study highlighted how enhanced defensive rotations and shooting distribution balance led to measurable improvements in team performance. These results validate the role of big data as an essential tool for modern sports, bridging the gap between traditional coaching methods and the demands of contemporary athletic competition. Despite these successes, challenges remain. Issues such as data standardization, privacy protection, and accessibility of advanced technology for smaller teams must be addressed to ensure the widespread adoption of big data in sports. Additionally, the effective interpretation of complex data requires

continuous education and collaboration among coaches, analysts, and athletes. In conclusion, big data represents a transformative force in sports training and coaching, driving innovation in decision-making, tactical execution, and leadership development. As technology continues to evolve, its integration into sports science will undoubtedly deepen, offering new opportunities to optimize performance and unlock the full potential of athletes and teams. Future research should explore the application of big data across diverse sports and competitive levels, ensuring that its benefits are accessible to all stakeholders in the sports community.

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